Flexible Pipe Technology Initiatives

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The Initiatives

- Flexible Pipe Technology JIP

- Flexible Pipe Survey & Integrity Assurance Guidance Note
  A comprehensive update of original the UKOOA documents
  An Oil & Gas UK initiative subcontracted to MCS
Contents

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Background to the FPT JIP

- API Spec 17J & RP 17B published in 1996 &’98, respectively
- Success in the industry universally recognised
- Basis of this success:
  - Collation of State-of-the-Art at that time
  - Identification of settled technology
  - Consensus on minimum requirements between operators, suppliers and regulatory bodies
- Since then:
  - State-of-the-Art has evolved
  - More operational experience with unbonded flexible pipe
  - New technology incorporated
  - More challenging applications, e.g., deeper waters etc.
  - Significant new learnings
    - JIPs, Rilsan User’s Group, Operator experiences
    - MCS UKOOA work
Background to the FPT JIP

Total Number of Operational Riser Years in North Sea and West of Shetland

Up to Year

Riser Years

Field

Years in Operation

Visund
Veslefrikk
Varg
Troll C
Troll B
Triton
Teal/Guillemot
Snorre TLP
Snorre B
Schiehallion
Ross
Pierce
Nome
Njord
MacCulloch
Leaon
Jotun
Janice
Ivanhoe/Rob Roy
Hudson
Heidrun
Harding
Gryphon
Galley
Foinaven
Fergus
Flora
Fife
Dunaward / Dauntless
Cook
Curlew
Captain
Buchan
Blenheim
Barff
Barff
Barff
Balnoral
Balder
Asgard C
Asgard B
Asgard A
Angus
Anasura
Alba

0 5 10 15 20

0 200 400 600 800 1000 1200 1400 1600

Background & Overview of FPT JIP

- In response:
  - A new generation of company specs have developed giving supplementary requirements
- Threatens the pre-eminence of 17J in the industry
- Not in the interests of either operators or suppliers
Background to Oil & Gas UK Flexible Pipe JIP

- In 2001 and 2002, MCS, under the auspices of Oil & Gas UK (then UKOOA), created two documents:
  - “State of the Art Flexible Riser Integrity Issues”
  - “Guidance Note on Monitoring Methods and Integrity Assurance for Unbonded Flexible Pipe”

- These documents have been widely adopted by the industry on an international basis, however considerable feedback suggested these documents require updating.

- The outcomes of this work will enable best-practice integrity assurance of flexible pipe in addition to comprehensive statistics of damage and failure for future reliability analysis of new flexible pipe designs.
Objective of the FPT JIP

- Bring together flexible pipe stakeholders
  operators, suppliers, designers, regulatory bodies
- Identify new settled technology in key areas
  design criteria, materials, manufacturing, qualification/testing, life-time integrity management, etc.
- Re-establish an industry consensus on minimum technical requirements
- Update the API and ISO standards
- To develop a design philosophy for flexible pipe
- Strive for consistency with the requirements for other offshore tubulars in the subsea system
- Provide a forum to promote knowledge transfer
- Help to ensure that flexible pipes remain a competitive, enabling solution
Objective of Oil & Gas UK Flexible Pipe JIP

- A global initiative
- Prepare a new State-of-the-Art document
- MCS will perform a high level “gap analysis” for each participant to the JIP based on the information provided by them during the questionnaire and interview phases of the project
- A collaborative effort
- Update the UKOOA documents
Current Participants (22)

- Operators (11): Agip, BP, Chevron, ExxonMobil, Inpex, Petrobras, Petronas, Shell, StatoilHydro, Woodside, Total

- Manufacturers (4): DeepFlex, NKT Flexibles, Technip Flexi France, Wellstream

- Contractors (4): Acergy, Saipem, SBM, Subsea7

- Regulatory Bodies (3): API, HSE (UK), Petroleum Safety Authority (Norway)
Knowledge Transfer & 3rd Party Initiatives

- Work of the FPT JIP is not being carried out in a vacuum
- JIP is actively seeking input, lessons learned from relevant third parties
  
  Serves to inform the develop of the revised standards
  Provides a forum for knowledge transfer between stakeholders
  - www.mcs.com/fpt_jip/forum

- FPT workshops have included contributions from:
  
  DNV, Limit State Design
  - Acceptance Criteria for Offshore Components (A. Echtermeyer)
  NTNU, Reliability-based Methods
  - Fatigue Design Formats for Flexible Pipe (B. Leira)
  Technip, Update to API RP 2RD (P. Stanton)
• Joint FPT JIP – InDec Polymer JIP Workshop
  Providing update on
  ▪ PA-X JIP
  ▪ SESAM PA11
  ▪ SESAM XLPE
• These have influenced thinking in development of candidate design philosophy for flexible pipes and provided valuable input to the core areas of investigation
Core Areas of Investigation

- Design Requirements
- Manufacturing (currently with MWG)
- Qualification and Prototype Testing
- Integrity Management

- Other fundamental investigations:
  - Design philosophy
  - Scaling rules
• Design Criteria
  Not proposed to change existing (Table 6) stress, strain criteria but to understand and document origin of existing Design Philosophy to provide a basis for changes in the future, if justified
  Exception
    ▪ PA Normal Operation – 0.67 (from 0.55)

• New criteria
  Survival – allowable stress utilisation of 0.97
  Remove depth dependence of buckling load utilisation – 0.85
  High strength tapes – allowable stress utilisations
  Armour wire buckling load criteria
Design Requirements

- Polymer Materials
  A complete re-appraisal of design criteria
  Work by M. Eriksen (Noble Denton InDec) and a Manufacturer’s Working Group (MWG)
  Remit:
  - Requirements in ISO 13628-2 to be material independent
  - Develop test protocols
  - Limits for each material based on field experience to be included in ISO 13628-11
Qualification and Prototype Testing

- Currently lack of clarity on purpose of tests and quantitative acceptance criteria
- Now all tests given clearly defined purpose, procedure and quantitative acceptance criteria
- Factory Acceptance Testing
  - Introduction of a sealing test
    - to confirm the integrity of the external sheath and sealing / crimping of the external sheath at the end fitting
    - Vacuum or positive pressure test acceptable
What constitutes a new pipe design?

“A pipe concept whose constituting materials, design methodologies, manufacturing processes, and prototype testing results have not been reviewed and accepted by an Independent Verification Agent”;

“A pipe concept whose performance, for a specific application, has not been approved by the purchaser through results, submitted by the manufacturer, of theoretical complementary analyses and of prototype tests”.

Qualification and Prototype Testing

- Prototype test
  The purpose of a prototype test is to establish and/or verify a performance characteristic for a new pipe design.

- Prototype qualification test,
  A prototype qualification test establishes the performance limits for a new pipe design.

- Prototype proof test
  A prototype proof test establishes the fitness-for-purpose of a new pipe design for a specific application.
Qualification and Prototype Testing

- New prototype tests being considered
  - Thermal cycling test
  - Insulation/cool down time test
  - Touchdown compression test
  - DIP test
  - Deepwater lateral buckling test
  - Vent valve qualification test
  - Prototype test for mid-line connections
  - End fitting resin filling
- Existing small-scale and full-scale test protocols are being re-appraised in light of above and also knowledge transfer
  - E.g., *Corrosion Fatigue JIP* (test protocol for fatigue testing of armour wires)
Integrity Management

- General philosophy
  Note name change – ‘Integrity Management’
  IMS should include a feedback element
  Begins at design
- Expanded objectives
- Expanded inspection/monitoring programme
  Increased emphasis on FAT Vacuum testing
  IMS should define clear operating envelopes
  Operating manual requirements
- Anomalies and repair requirements
Integrity Management

- Failure modes & defects
  Tables of potential failure defects and modes updated
  - New pipe structures
  - Lessons learned from experience

- Monitoring methods
  Types of monitoring methods updated to reflect state-of-the-art (Table 33)
  Limitations on use of various methods
  Inclusion of new methods
  - annulus PBU
  - vacuum testing, incl recommended procedure
  - eddy current
  Expanded recommendations
  - Inspection intervals
Integrity Management

Monitoring Methods

- CP tests
- Annulus vacuum tests
- Flooded member testing
- Laser Leak Detection
- Tether monitoring
- Bend stiffener strain measurement
- Bend stiffener location curvature and tension monitoring
- Subsea annulus vent monitoring
- Bend stiffener sonar measurement (experimental technique)
- I-Tube camera
- Vibration monitoring
- Polymer degradation
- Produced sand monitoring
- Riser flushing checks
- Vessel transit
- Dropped object reporting
- Fibre optic monitoring
FPT JIP Status

- FPT JIP is tasked with producing major revisions to the API and ISO standards for unbonded flexible pipes
- A draft revision of the Specification document has been substantially completed
- A design philosophy is under development based on a hybrid limit state and working stress design approach
- Future work includes:
  - update prototype testing requirements
  - a re-evaluation of polymer material design, manufacturing and qualification issues
  - re-structure the Recommended Practice to facilitate its application as a user-orientated guidelines document
- Planned completion
  - Q1/Q2 2009
- Flexible Pipe Forum will continue ...
Oil & Gas UK Flexible Pipe JIP Status

- 13 confirmed participants with flexible pipe experience in North Sea, West of Africa, Asia/NW Australia, Gulf of Mexico and Offshore Brazil
- New State-of-the-art document at an advanced stage of development
- Expected completion mid-2009
Questions?